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ABSTRACT

Presented for use with normal and handicapped children are guidelines for the development of computer based resource units organized into two operations: one of which is the production of software which includes the writing of instructional objectives, content, activities, materials, and measuring devices; and the other the coding of the software components in preparation for computer retrieval. One of the five aspects of writing instructional objectives discussed is criteria such as that objectives should be behavioral and student oriented. Selectivity is seen to be the critical consideration in writing content items. Also given are guidelines for specifying materials and formulating activities. It is suggested that measuring devices be imaginative, varied, and possessed of adequate achievement criteria. Each component (objective, content, activity, material, or measuring device) is identified by number and coded to both objectives and variables. Fourteen variable categories such as student interests and physical handicaps are considered in terms of coding guidelines. Examples of coding sheets and a listing of appropriate categories for coding variables are given as well as 248 instructional variables listed under the 14 major categories. See also EC 051 239 through EC 051 241 for related documents. (DB)

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GUIDELINES FOR DEVELOPING COMPUTER BASED RESOURCE UNITS

PROFESSIONAL STUDIES RESEARCH AND DEVELOPMENT COMPLEX

STATE UNIVERSITY COLLEGE AT BUFFALO

Revised March, 1972

EC 051 238E

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INTRODUCTION

The following work represents a synthesis of the thinking of many educators who have worked closely with the development and refinement of Computer Based Resource Units over the major part of the last decade. This concept for using computers for curriculum planning was originally conceived and implemented by Professor Robert S. Harnack, State University of New York at Buffalo.

Since the nature of instruction, the role of the classroom teacher, and the needs of learners are currently undergoing drastic changes, the information contained in a Computer Based Resource Unit may not be the same kind of information educators will need in the future. Therefore, these instructions should be viewed as currently the most helpful guidelines which can be documented for developers of Computer Based Resource Units.

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DEVELOPING COMPUTER BASED RESOURCE UNITS

The development of a Computer Based Resource Unit (CBRU) includes two distinct, separate, and equally important operations.

Operation I: The first operation involved production of the software, i.e., the writing of instructional Objectives, Content, Activities, Materials, Measuring Devices.

Given a center of interest or a unit topic such as "Drugs and Narcotics", those persons responsible for formulating the software (Unit writers) must produce a series of instructional Objectives related to the topic. Subsequently, instructional Content, Activities, Materials and Measuring Devices (the components) which are related to one of more of the objectives must be developed or identified.

The production of these five components involves a great deal of professional expertise and imagination so that literally hundreds of Objectives, Content Items, Activities, Materials, and Measuring Devices will be available to teachers whose students possess a wide variety of interests, needs and aptitudes.

Operation II: The second operation involves the coding of the aforementioned components in order to prepare them for computer retrieval. Each statement is assigned an identification number, and through the use of coding forms, every Content Item, Activity, Material, and Measuring Device is coded to every Objective to which it is related. In many cases, one Activity may be related to two, or three, or more Objectives. Subsequently, each statement is coded to several learner characteristics so that, for example, an instructional Material is assigned to its appropriate "reading level." Other learner characteristics would be student interests, sex, chronological age, etc.

Once these two operations have been completed, data clerks will enter all written and coded information into computers. The result is a Computer Based Resource Unit stored on disk for retrieval.

By following specified procedures, a teacher can obtain a Computer Based Resource Guide which, generally, consists of two parts:

Part A: For each objective selected, the teacher will receive all of the appropriate content, large and small group activities, materials, and evaluation devices related thereto. This material is for use with the total class.

Part B: Each student will receive an individually tailored curriculum guide related to the objectives selected and screened on the basis of his unique characteristics.

The information which follows will provide suggestions and guidelines related to these Operations.

I. WRITING INSTRUCTIONAL OBJECTIVES:

A. Characteristics: Unlike "Mager" type objectives, the Objectives which are formulated for Computer Based Resource Units are less specific and do not include the "criteria of success" or measuring devices. Inherent in the concept of CBRU's is the posture that individualized instruction denotes -- among other things -- that the means for meeting or achieving a particular objective may vary from child to child, depending upon his interests, needs and aptitudes. An instructional objective, therefore, should be specific enough to be measurable but general enough to be measured in a variety of ways.

B. Criteria: Following are a few general criteria for writing instructional objectives for CBRU's:

1. Behavioral: The objective must call for performance of a measurable task -- listing, naming, analyzing, using, locating -- as opposed to some vague act such as knowing or understanding.

Poor: To know the factors in production which affect prices.*

Better: To analyze the factors in production which affect prices.

Poor: To understand that contaminated air has an affect on lung ailments.

Better: To explain the effect of contaminated air on lung ailments.

2. Student Oriented: The objective must call for the performance of a specific task by the student, rather than by the teacher. If teachers perform the behaviors, they will probably do most of the learning.

Poor: To help students understand the principles of evaporation and condensation.

Better: To explain the principles of evaporation and condensation.

Poor: To teach the criteria for a balanced diet in the preparation of a meal or menu.

Better: To apply four criteria for a balanced diet in the preparation of a meal or menu.

3. Relevant: The objective must call for student behavior which makes some difference. The number of instructional objectives is theoretically infinite. Therefore, selectivity must be based on some social demand, student need, or philosophical imperative.

*The phrase, "The Student will be able..." is understood to precede each objective written for a CBRU.

Poor: To memorize the trigonometric tables.

Better: To use the trigonometric tables to determine mathematical relationships.

Poor: To describe ten different types of abodes -- pueblos, igloos, castles, etc.

Better: To explain the geographical and environmental factors which account for mans' choices of housing.

4. Observable: The objectives must call for behavior which can be evaluated. If objectives chosen were not observable, it would be irrelevant for evaluating student progress of identifying future goals. This criterion should also provide for the consideration of a wide range of measuring devices; especially those which do not involve the usual pencil and paper test.

Poor: To appreciate the reasons why barter is obsolete.

Better: To analyze the reasons why barter is no longer feasible in our economy.

Poor: To value the democratic process.

Better: To value the democratic process by using compromise as a means for problem solving.

5. Single Factor: The objective must call for a single behavior in order to minimize confusion in the evaluation procedure. If more than one behavior is called for, then more than one interpretation will be possible for the evaluation of the objective.

Poor: To list and define the requirements of effective communication.

Better: To list the requirements for effective communication.

6. Flexible: If the objective is too specific, the Content, Activities, Materials, and Measuring Devices for use with that objective will be severely limited and will not permit the modification of approaches necessary for accomodating individual differences in students.

Poor: To write the eight meanings of the word "power" as explained in Webster's Lighth New Collegiate Dictionary.

Better: To analyze the ways in which the word "power" may be used.

The criteria just listed represent an ideal situation which, given the state of the art, we can only approach. To arrive at the statement of an objective which is absolutely behavioral, relevant, easily observable, and simultaneously allows the flexibility required for individualizing instruction, is, in most cases, extremely difficult. However, if these guidelines are kept in mind while writing, and if they are consistenly applied, the resulting objectives should be extremely useful in developing computerized units and in planning teaching-learning experiences which will facilitate the individualization of instruction.

C. Prevalent Types: Educational objectives are often divided into three categories: Cognitive, Affective, and Psychomotor. For our purposes, this division is academic except as it applies to a condition which has been demonstrated in the process of developing previous CBRU's. The vast majority of objectives which have been formulated for CBRU's would be classified as cognitive. The use of cognitive objectives has developed as a result of the position contemporary education has taken to desparage the vague approach to objective writing. Affective objectives generally fall into this category because the evaluative criteria for such objectives are extremely difficult to define, implement, and measure. Therefore, in preparing objectives in the affective domain, the writer must also include a description of student behavior which can be used as acceptable evidence of an internalized affective change.

D. Language Level: An additional consideration might be the level of language utilized in writing objectives. Since most teachers using CBRU's may want to involve the students of various grade levels in the consideration and selection of instructional objectives, it is a good practice to avoid excessively sophisticated, complex or esoteric terminology when formulating instructional objectives. On the other hand, clarity of an objective should not be sacrificed for the sake of brevity.

E. Complexity of Objectives: Bloom & Krathwahl's classfiication of educational objectives (Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation) has been utilized as a convenient method for determining the extent to which persons who are formulating instructional objectives have effected a reasonable balance between those which are quite simple and those which are relatively complex. It should be noted, however, that this does not imply that a certain predetermined number of objectives should be written for each of Bloom & Krathwahl's classifications, but by classifying the objectives, problems of imbalance can be identified and ameliorated. In the past, for example, it was noted that a disproportionately high number of Classification I (Knowledge) objectives were being written, while Classification III (Application) objectives were virtually non-existent. Subsequently, this condition has been remedied to some extent.

II. DESIGNATING CONTENT (SUBJECT MATTER)

Content (subject matter) is informational data; the facts, statistics, generalizations, concepts, and definitions which will facilitate the achievement of a particular objective.

Content, in the CBRU concept, is relegated to its proper role, i.e., the informational means for achieving an objective, and not the end result itself. In other words, in order to achieve some objectives, a student must have at his disposal, certain concrete cognitive data: facts, statistics, generalizations, etc., related to that objective. Content consists of such information.

Unlike the other components of CBRU's -- Objectives, Activities, Materials, Measuring Devices -- the critical consideration in writing content items is selectivity. Theoretically, the number of content items which can be written for any topic is infinite. Therefore, careful consideration must be given to the number of content items which will be written, their format, and their scope.

Following are the general guidelines which should be considered when writing content items.

It should be initially noted that the content component of CBRU's is designed primarily for use by the teacher rather for the the individual student, in that it serves to provide the teacher with a general inventory of some of the basic facts, statistics, and generalizations related to the unit topic. Content acquisition for the student, however, should not be via a pre-determined listing of facts and concepts, but should accrue as a result of one's interaction with pertinent materials and activities. Since content is primarily a teacher resource, each item should be more than a simplistic one line statement which denotes an obvious fact. Rather it should be a comprehensive statement which may include a useful concept, a stimulating thought, or a provocative statistic.

2. Content items should be written with a general grade level range in mind. If the unit under consideration is designated Grades 4-6, the complexity or sophistication of the content item should probably fall within the application and relevance range of students from Grades 2-8. This would allow for exceptional classes at either extreme.

3. Generally speaking, content items which are written as statements or generalizations seem to be the most useful. There is no specific rule which determines how to write the content item, but the complexity of the objective will often provide the necessary clues. If, for example, an objective is quite simple, definitive and limited in scope (to list the differences between stimulants and depressants), the content items would be similarily limited and rather specific. On the other hand, a complex objective (to evaluate the effectiveness of existing drug withdrawal programs), will accommodate a wider range of content which might include generalizations as well as specific statements.

III. DESIGNATING MATERIALS AND ACTIVITIES

A. Once an objective and related content have been written, the means -- the "how" -- whereby one is to be exposed to this content, must be determined. This is accomplished through the use of materials and activities. While materials and activities appear to serve the same function, they differ in the sense that activities are "experiences" while materials are "sources". Even this differentiation can be disputed and the tendency might be to classify activities and materials under one heading. For the purpose of developing Computer Based Resource Units, however, activities and materials will be classified separately. The reasons for this separate classification are varied, but presently, it is sufficient to note that by separating activities and materials, the student and teacher will receive a less complex Computer Based Resource Guide, resulting in easier interpretation, analysis, and utilization.

B. Guidelines for specifying Materials.

1. Materials include books, booklets, pamphlets, audio-aids, audio-tapes, film strips, simulation games, and invited persons, etc. The tendency to overemphasize printed material to the exclusion of a wide variety of other viable sources should be avoided.

2. Materials listed should be relevant to some segment of the student population designated in the unit. Esoteric treatises and doctoral studies, for example, would not be included in a K-6 unit, and probably not even in a 7-12 unit. At the other extreme, a film entitled "The Fireman is Your Friend", would probably be ignored by teacher and student alike in a senior high school.

3. Indiscriminate lists of materials should be avoided. If the teacher, in his professional opinion, deems a material totally ineffective, it should not be listed. The fact that a material did not work for one particular classroom, however, might not be a sufficient criterion for exclusion.

4. If the materials being considered are out of print, dated, difficult to obtain, or difficult to visit, careful reflection should precede the decision to include them.

5. Materials should be listed in the following way:

   a. The type of material -- book, chart, filmstrip, etc.

   b. Citation should be taken from the title page and should include:

      1. Author, editor, or Corporate Name (If joint responsibility, please note joint author, editor, etc.)

2. Actual title of the material
3. Edition note (if more than one edition, please note edition used)
4. Place of publication, publisher's name, date of publication or copyright date
5. Paging or volume numbering, size - if unusual, illustrative information - if important
6. Series
7. Cost of the material - note if material is free

Whenever possible, specify those segments of the material which are pretinent to the Objective. A complete book should not be recommended if only one or two chapters are pertinent. Equally undesirable is the listing of isolated sentences or paragraphs which, if read in isolation might be meaningless or confusing.

C. Citations for periodicals should include:
Author, Title of article (in " "s), Title of periodical, Volume number, pages, month, year.

D. Citations for non-book materials should include:
1. Author (if none use vendor)
2. Actual title of the material
3. Vendor
4. Copyright date (if none use n.d.)

If possible, please include this information:

5. Charts, maps, pictures, slides: number, size, color or b/w
6. Films: millimeters, running time, color or b/w
7. Filmstrips or Filmslides: Number of frames, color or b/w
8. Film loops: standard or super, color or b/w
9. Study prints, flash cards, games, models, specimens, and program learning kits: short statement of what material consists of
10. Phonodiscs: number of discs, diameter in inches, rpms
11. Tapes or cassettes: number of reels, speed in inches, per second, time in minutes

E. At the end of each material listed, at least two or three sentences should be included to describe the content of that particular material.

Two examples of such annotations follow:

1. Book. Ruben, G.H. and Archer, G.A. "What is a Magnet?" Chicago, Benefic Press, 1961 48 pages, slim hard-back, the "What Is It?" Series $1.50 excellent lay-out, colored pictures and diagrams, simple explanations and directions for experiments includes natural, artificial, temporary, permanent and electro magnets, picture and word dictionary. Excellent teacher resource. Accompanying Filmstrip available.

2. Filmstrips-Record. "Let's Listen" including "Exploring City Sounds", "Cows Don't Say Moo" Chicago, Coronet Films Cat. No. S105, Complete set $15.00. First Filmstrip 55 frames, 9 minutes, Second Filmstrip, 45 frames, 11 minutes 12-inch 33 rps record American Film Festival Award, Best Filmstrip for primary grades. Trip around farm shows that animal sounds usually can't be written with our alphabet. Trip through city develops listening skills by having children guess source of the sounds. Full color.

G. Guidelines for formulating Activities:

1. Activities should be within the realm of feasibility in terms of performance by students, length of time, cost, and accessibility of materials and facilities.

2. Activities should be written in such a way that the teacher and student have a clear understanding of what is to be accomplished. An activity which states, "interview a drug addict", might be meaningless to a teacher or student unless it provides some supplementary information concerning possible questions to be asked, experiences to consider, and follow-up activities.

3. For purposes of clarification, a basic title such as: field trip, debate, role play, bulletin board, etc. should precede the actual description of the activity where appropriate.

4. Be aware of the virtual endless variety of stimulating instructional activities which can be formulated by a teacher with sufficient experience and a fertile imagination. No matter how well formulated the instructional objective is, the means for achieving that objective -- the activity -- must be interesting, exciting, and relevant enough to encourage a student to pursue it.

5. Developing activities involves the consideration of a wide variety of approaches and contexts. Activities involve a variety of possible approaches which should be considered. There must be activities for large groups small groups and individual students. Further, activities can be introductory (highly motivational), developmental (directly related to the objective), or culminating (practicing what has been learned). This is not to say that each activity can only fit in one of these categories. Indeed, in many cases an activity can be considered appropriate for an individual student and small group as well; or it can be properly used in an introductory and developmental capacity. The important consideration concerns the need to include a wide variety of interesting activities which will accommodate all of the approaches mentioned above.

6. Whenever possible, instructional activities should:

a. Allow the student some decision making alternatives rather than assigning him a specific task.

b. Place the student in an active rather than a passive role.

c. Cause students to be involved in real situations rather than fabricated activities which have no value or applicability outside of the classroom.

d. Examples of Activities:

1. Conduct an "anti-smoking" campaign in your school using those media which will be most appropriate for your purposes.

2. In cooperation with a woodworking or shop class, or an interested community group, have the class provide nests, boxes or other havens for birds and mammals to use on a portion of the school property.

3. Using the school building and home as examples, students can describe the things that man has done to alter the natural environment (air conditioning, heating, lighting, construction, etc.). The list may be expanded to changes beyond home and school. Students can react to such questions and concerns such as:
   - Are these alterations beneficial to humans?
   - What indirect or long-range consequences have we caused to take place?
   - What are some of our plans for the future which require manipulation to the environment?
   - Can we completely control our environment? Should we? Why or why not?

IV. FORMULATING MEASURING DEVICES

A. One of the most consistently valid determiners of the quality of a Computer Based Resource Unit has been the extent to which the measuring devices have been, 1) imaginative, 2) varied in terms of approach and sophistication, and 3) possessed of sufficient criteria for determining how and whether the objective has been achieved.

B. Guidelines for Developing Measuring Devices:

1. Imaginative: Ideally, any list of evaluation devices should include all of the possibilities available to teachers. Too often and too easily, however, paper and pencil objective tests are the only type considered. Without disparaging paper and pencil objective tests, it seems reasonable to assume that a wide variety of other testing techniques should be available for the creative teacher who wishes to individualize instruction. Additionally, a source of varied measuring devices might serve to stimulate the less imaginative teacher.

   Essays, rating scales, oral questioning, log diaries, checklists, anecdotal records, role playing, original productions, etc., are just a few of the possible instruments which can be utilized to determine the extent to which an objective has been achieved.

Of course, most of the above examples are surrogate standards for the "real" world. The ideal evaluation device is one which allows the learner to apply his newly acquired knowledge and/or skill toward the solution of an actual problem, or the creation of a useful product. For example, the best way to evaluate a student's ability to make a high quality coffee table is to have him make a coffee table and attempt to sell it. Or, an objective which requires that a student concern himself with techniques for influencing legislation on a local level, could be ultimately concluded by having the student or students devise and implement a plan for proposing a town law.

Some subject areas and some objectives naturally lend themselves better to this concept of evaluation than others. Additionally, such evaluative devices are often difficult to consider in terms of time and complexity. But it is this concept of evaluation which should be carefully considered and, whenever feasible, utilized, along with some of the more common forms of testing.

2. Varied: A description of a varied approach would include some of the elements of Item #1. Additionally, however, a varied approach implies that one particular objective may be amenable to a variety of evaluative techniques, rather than simply one.

   Further, the achievement of a single objective can be measured at various levels of sophistication. Although two students may be concerned with the same objective, their individual intellectual aptitudes may vary greatly. Whenever possible, therefore, evaluation devices which coincide with a variety of aptitudes should be considered.

3. Achievement Criteria: It is not rare that an activity can be interchanged with a measuring device. To "give an oral report to the class discussing some of the characteristics exhibited by a drug attict," might serve equally well as an activity or as a measuring device. It would be a better measuring device, however, if the unit writer would include -- among other things -- the following: "This report should include at least one psychological, sociological, and physiological characteristic."

   When writing a measuring device which includes some achievement criteria, the question of specificity is important. To what extent should a unit writer literally "write out" the complete evaluation device, question by question? Often this type of specificity is impractical, unnecessary, and difficult to achieve. The unit writer must, therefore, search out the "happy medium" between measuring devices which are so vague that they probably provide nothing of value to the classroom teacher, and those which are so specific and detailed that they are impractical for use in a CBEU in terms of length.

   One approach is to specify the type of evaluation device to be used; give adequate direction for its administration; and give several illustrative examples of the items to be used.

Often standard exams are available which are excellent measuring devices. In these cases, the unit writer should briefly explain the purpose of the exam and note its source.

At this point in the progress of CBRU's, there is no doubt that the formulation of meaningful, imaginative, relevant, varied and realistic evaluation devices is the most formidable chalienge for unit writers.

V. SEQUENCE FOR PREPARATION OF COMPONENTS

Although these guidelines described the preparation of content, materials, activities, and measuring devices in that order, the sequence in which the components should be developed is not necessarily the same. Indeed, experience has shown that once objectives have been formulated, the developmental sequence of the remaining components have varied depending upon the particular group involved.

GUIDELINES FOR CODING COMPONENTS TO OBJECTIVES

The Objectives specified in a unit of instruction are achieved, in part, by the effective utilization of subject matter (Content), Activities, and Materials and the use of Measuring Devices to assess that achievement. The computer can assist the teacher in organizing these components and increase his accuracy and efficiency in decision-making. By sorting data on the basis of desired learning outcomes and instructional variables, the computer can provide the teacher with suggestions which are of optimal utility for his particular class. This is accomplished through the coding process described here.

Each Objective, Content Item, Activity, Material and Measuring Device developed for a CBRU must have a unique identification number. That is, Objectives are numbered consecutively from 1, Content Items are consecutively numbered from 1, and so forth for Activities, Materials and Measuring Devices. These unique numbers are the data "read" by the computer, thus omissions or duplications will result in no output or even worse, inaccurate output.

Each statement (except Objectives) must be coded twice; once to Objectives and, once to Variables (Objectives are not coded to Objectives). Following are the directions for this essential process.

CODING COMPONENTS TO OBJECTIVES

Procedures for filling in coding forms (see Appendix 1)

1. Write in the title of the Unit.
2. Write in the number of the Unit.
3. Note the category Content, Activities, Materials, Measuring Devices and write it in below the word "Category".
4. Place a circle around the word "Objectives" to indicate that items on this form are being coded to "Objectives".
5. Refer to the "Variables" sheet which is appropriate to the category you are coding.
6. Study the particular category statement and determine which variables are appropriate for the particular statement.
7. Note the number of the variables.

   Ex: (refer to sample coding form)
   Activity number 1 is apparently related to variables number 9, 13, 41, 65, ... 258. Activity number 4 is coded to a large number of variables; therefore the variables were continued on the next line.
8. Study the particular statement and determine to which Objectives it is related.
9. Write in the number of each Objective to which the statement is related.
10. Begin coding the next statement on the next empty line.

NOTE:

Coding of Specific Content Item, Activities, etc., to more than 15 to 20% of the Objectives of a given unit can result in excessive repetition in the guide received by a classroom teacher.

GUIDELINES FOR CODING COMPONENTS TO VARIABLES

In preparing instructional material for computer retrieval, i.e., Computer based Resource Units, it is necessary to indicate those student or instructional characteristics which are most closely related to each OUjective, Content Item, Activity, Material and Measuring Device. That is, given a list of instructional Activities, a coder must determine which "interest" areas, or "instructional" groupings", or "mental ages", for example, are most closely related to each Activity. This coding, therefore, serves as a screen by limiting the number of suggestions a student will receive, this limitation being based upon those unique characteristics of each student.

Without this coding procedure, every student would receive all Activities and all Materials related to a particular Objective. Under such circumstances, there would be no individualization of instruction and there would be no need to utilize a computer

The coder, therefore, has the extremely vital responsibility for carefully analyzing each Objective, Content Item, Activity, Material and Measuring Device, and then coding each item to its appropriate characteristics (variables).

This operation is both mechanical and intellectual - mechanical in the sense that the coder must follow a procedure which involves the listing of numbers on coding sheets; intellectual in the sense that the coder must make intelligent, professional decisions concerning the relationships between individual student characteristics and Activities, Measuring Devices, etc. This operation is so critical that despite the high caliber of material which has been written for various Units, less than high quality Computer Based Resource Guides have been generated because of some questionable coding procedures.

In strict operational terms, coders must adhere to the following procedures:

1. Given a list of instructional Activities, for example, related to a particular Unit, the coder - using a coding sheet (Appendix #1) - will first indicate the Unit title, and the Unit number in the appropriate place.

2. The coder will then indicate that he is coding "Activities" to variables by writing this term below the heading CATEGORY.

3. Each "Activity" for a given Unit has been assigned a number. The coder will note this number on his coding sheet in the left hand column and then proceed to indicate the numbers of variables which are related to that particular "Activity".

4. Since each of the components - Objectives, Content Items, Activities, Materials, Measuring Devices, - is distinctive in terms of its application to a teaching-learning process, the variables to which it will be coded will differ in some respects. That is, while a Material such as a book can be coded to reading level, it would be virtually impossible to code a Content Item to a reading level, and it would be educationally meaningless as well. The coder, therefore, will address himself to a different list of variables for each of the components. (See Appendix #2)

Coding Components To Variables

Procedures for filling in coding forms

1. Write in the title of the unit.
2. Write in the number of the unit.
3. Note the category Objectives, Content, Activities, Materials, Measuring Devices, and write it in below the word "Category". (NOTE: only one "Category" can appear on any single page.)
4. Place a circle around the word "Variables" to indicate that items on this form are being coded to "variables".
5. In the "Category" column, write in the identification number of the statement you will be coding.
6. Determining the catagories to which this item will be coded by referring to Appendix 2.
7. Refer to the "Variables" sheet which is appropriate for the type of item you are coding.
8. Study the particular statement and determine to which variables it is related.
9. Write in all the variable numbers appropriate to that statement using more than one line if necessary. (NOTE: where an item is coded to a range of variables, e.g. Mental Age 203 to 207, an arrow may be used to designate the range.)
10. Begin coding the next statement on the next empty line.

VARIABLES CATEGORIES

1. Student Interests (Number 1 on Appendix 3): There are more than thirty student interests to which the components - Objectives, Content Items, Activities, Materials and Measuring Devices - can be coded. Most of them are quite specific while others

are vague and may be subject to misinterpretation. This condition exists since we are presently at the stage where experimentation with definitive terminology for student interests is still being analyzed.

For the coder, this means that ascertaining which student interests apply to certain components is not a simple "yes or no" process. For example, an Activity which states, "From the radio and television programs listed in the daily paper, make a list of the different types of entertainment and informational services offered", can conceivably be coded to the following student interests: sports/recreation, communication, psychology, education, sociology/family living, performing arts. Rationale for each of these student interests can be logically explicated even though there will probably never be 100% agreement among a group of teachers. Since this coding procedure is intellectually demanding, the following guidelines may be helpful:

a. Hopefully, any component should be coded to more than one student interest; the median seems to be five or six although certain activities which are quite comprehensive in nature have been coded to many more.

b. The decision as to whether a particular student interest should be coded to a statement should be based upon the coder's best intuitive and intellectual judgment. In other words, the coder will ask, "Would a student who is interested in anthropology profit from this particular Activity (or Content Item, or Material, or Measuring Device?) If the answer is yes, then anthropology should be coded to the Activity. If the answer is "51% yes as opposed to 49% no", the item should still be coded. Most decisions will enter into this "grey area" and then one's best judgment must prevail.

2. Sex (4): Some statements (i.e., Activities, Materials) may be more appropriate for one sex than another (our apologies to members of the women's liberation movement). If this is indeed the case, make the distinction by indicating only one variable in this category. If the statement has equal validity for both sexes, include both variable numbers.

3. Developmental Tasks (5): Developmental Tasks are somewhat chronological in nature. That is, developmental tasks in the 70's are more related to elementary school children whereas the high 80's and 90's items deal more so with high school students. The purpose of including this catagory of variables is to identify Activities and Materials which not only facilitate achievement of objectives related to the Unit topic but are also helpful in developing these critical skills. Designate all Developmental Tasks which are appropriate for each statement even if the range spans both elementary and secondary classifications. If none apply, ignore the entire catagory.

4. Major Social Functions (6): These variables represent those societal conditions in which all individuals must participate at sometime in their lives. Many concepts (Content Items, Activities, Materials) clearly fall into one or more of these categories. By indicating as many variables to which a statement is related, the computer will be able to generate suggestions related to only those concerns identified by a teacher/user.

5. Reading Level (7): In the same way that Chronological and Mental Age are coded in ranges of numbers rather than by designating one distinct number, reading level is more appropriately coded in terms of a range of grade levels rather than one. Determination of reading level is best accomplished through the use of a reading formula for determining grade level. Many such formulas are available. Some are quite easy to apply while others involve detailed analysis of eight or ten excerpts from the material. Some publishers indicate the reading level of their books and others will note ranges such as junior high, senior high, etc. Hopefully, where possible, coders will attempt to apply some objective criteria in determining grade level other than simply estimating.

6. Instructional Activity (8): This category serves to describe all Activities in a Computer Based Resource Unit. Often an Activity must be described by more than one variable. For example - "The student will construct a map of the United States out of construction paper. The variety of geographic regions (deserts, mountains, forests) should be labelled by picture postcards. The student can explain to his classmates, the various climates indigenous to each region" - could be coded as verbal, speaking, constructing/creating, and student led discussion. (NOTE: Non-verbal (124) indicates that the use of language is not necessary for completing a specific Activity.)

7. Suggested Approach (9): An Activity may be appropriate to more than one variable in this catagory. An activity described as extra-curricular (142) indicates that the student will be utilizing resources and following strategies not typically associated with the classroom environment.

8. Objective Types (10): The variables in this category designate the relative sophistication of a specific Objective as described by Bloom and Krathwohl.* A discussion of this classification scheme would be too lengthy for this document; therefore, the citation noted is recommended. Experience in developing Computer Based Resource Units has shown that specifying objectives at the lower levels of the taxonomy has resulted in severe restrictions on variability of approaches in achieving those Objectives.

9. Material Descriptor (11): The combination of variables in this category should be sufficient for describing almost any instructional material. More specific terminology is not used since it most naturally would be these characteristics of a material that would cause a teacher to make selections for classroom use and a list of specific instructional materials is virtually infinite.

10. Instructional Grouping (13): The major consideration for coding an Activity to variables in this catagory is to select the one designation which would provide the most effective environment for learning. Designating more than one mode of learning on a frequent basis results in a great deal of repetition for the teacher/user.

11. Evaluation Devices (14): Generally, most Evaluation Devices will be adequately described by one or more of the variables listed in this catagory. Detailed explainations of each variable is not possible in this document; however, much has been written in other sources to further clarify these descriptions. The Unit writer might also use this listing as a source of ideas for writing a variety of Evaluation Devices for specified Objectives.

12. Mental Age (15) and Chronological Age (16): In many respects, the consideration of Mental Age and Chronological Age must occur simultaneously. If a component seems to be apropos for a 6th grader of average intelligence then a Mental Age of 11 and a Chronological Age of 11 could be noted.

For purposes of convenience and necessary reflection, however, these two catagories will usually be considered separately. Following are guidelines for considering the coding of components to Mental Age and Chronological Age:

a. The coding for Mental Age and Chronological Age always involves a range of variables. That is, it is probably impossible to devise an activity or material which would be apropos for only one Mental Age and one Chronological Age.

*Bloom, Benjamin, et. al., Taxonomy of Education Objectives, David McKay Co., New York, 1956.

b. It would seem easier to commence with Mental Age, starting with the lowest possible level for the category. The coder might ask himself, "What is the lowest Mental Age where a particular component is intellectually comprehensible to the student?" In other words, what is the lowest Mental Age where this concept, activity or material can be understood or undertaken. The same question cannot be asked for determining the highest Mental Age since it follows that any Mental Age above the lowest would be appropriate. The upper limit of the Mental Age range designation should be determined by the level at which the statement would appear to be too trite, simple or ineffective.

c. Coding to Chronological Age should begin with a consideration of a statement in terms of its social appropriateness. There might be an item which is intellectually comprehensible to a student with a Mental Age of 6 years. This same item might not be socially or psychologically desirable for a student with a Chronological Age of 11. Therefore, this item might be coded to Mental Age ranging from 6 to 12, and the Chronological Age might range from age 6 or 7 to 10. Occasionally some coders find it convenient to convert Mental Age and Chronological Age to grade level designation.

Another approach is to consider the Chronological Age of a component in terms of its social appropriateness and then consider the I.Q. of the student. This will then provide clues for determining Mental Age. For example, a material which seems to be apropos for an average 6th grader would imply a Chronological Age of 11. If the coder concludes that a 6th grader with an I.Q. of 80 would also find this material appropriate, he can then designate a Mental Age of approximately 8 or 9. The coder can then consider an average 5th grader, and go on.

13. Physical Handicaps (17): This category of variables should be considered in the following context: "Will a student with this handicap benefit from this Activity, Material, or Measuring Device?" Since many instructional materials are available in braille or some other specialized vehicle, the Unit writer should search out such information and make sure that the information is included in the Material annotation and coded appropriately.

14. Learning Environment (20): This category is self-explanatory. More than one designation can be used to describe an Activity which utilizes more than one environment. NOTE: Since field trip Activities should also include follow-up classroom activities, they should be coded to both classroom (258) and outdoors (259).

APPENDIX 1

Coding Sheet for

Objectives

UNIT NUMBER 017

CATEGORY Activities	OBJECTIVES				VARIABLES					
124	5	6	12	23						
125	9	14								
126	1	3	18							
127	9									

APPENDIX 2

Appropriate Categories

For

Coding Components

APPROPRIATE CATEGORIES FOR CODING COMPONENTS

OBJECTIVES should be coded to the following variables categories:

1. Student Interests
4. Sex
5. Developmental Tasks
6. Major Social Functions
10. Objectives
15. Mental Age
16. Chronological Age

CONTENT should be coded to the following variables categories:

1. Student Interests
4. Sex
5. Developmental Tasks
6. Major Social Functions
15. Mental Age

ACTIVITIES should be coded to the following variables categories:

1. Student Interests
4. Sex
5. Developmental Tasks
6. Major Social Functions
7. Reading Level (if appropriate)
8. Instructional Activity
9. Suggested Approach
13. Instructional Grouping (one only whenever possible)
15. Mental Age
16. Chronological Age
17. Physical Handicaps
20. Learning Environment

MATERIALS should be coded to the following variables categories:

1. Student Interests
4. Sex
5. Developmental Tasks
6. Major Social Functions
7. Reading Level (if appropriate)
11. Material Description
15. Mental Age
16. Chronological Age
17. Physical Handicaps

MEASURING DEVICES should be coded to the following variables categories:

1. Student Interests
4. Sex
5. Developmental Tasks
6. Major Social Functions
7. Reading Level (if appropriate)
13. Instructional Grouping (one only whenever possible)
14. Evaluation Devices
15. Mental Age
16. Chronological Age
17. Physical Handicaps
20. Learning Environment

APPENDIX 3

Instructional Variables

INSTRUCTIONAL VARIABLES

1. STUDENT INTERESTS

1. Agriculture
2. Anthropology
3. Astronomy
4. Biography/Autobiography
5. Biology
6. Botany/Zoology
7. Business
8. Chemistry
9. Communication
10. Earth Science/Geography
11. Fine Arts/Crafts
12. Foreign Cultures/Languages
13. Folklore/Customs
14. History
15. Home Economics
16. Mathematics
17. Philosophy/Ethics
18. Physics
19. Political Science/Law
20. Psychology
21. Religion
22. Economics
23. Education
24. Engineering/Technology
25. Fiction/Mythology
26. Sociology/Family Living
27. Sports/Recreation
28. Transportation
29. Performing Arts
30. Medicine/Health
31. Adventure
32. Poetry
33. Creative Writing

4. SEX

72. Male
73. Female

5. DEVELOPMENTAL TASKS

A. Middle Childhood

74. Learning Physical Skills Necessary for Ordinary Games
75. Building Wholesome Attitudes Toward Oneself as a Growing Organism
76. Learning to Get Along With Age-Mates
77. Learning An Appropriate Masculine or Feminine Social Role
78. Developing Fundamental Skills in Reading, Writing, and Calculating
79. Developing Concepts Necessary for Everyday Living
80. Developing Conscience, Morality, and a System of Values
81. Achieving Personal Independence
82. Developing Attitudes Toward Social Groups and Institutions

B. Adolescent

83. Accepting New and More Mature Relations With Age-Mates of Both Sexes
84. Accepting One's Physique (Male and Female Role)
85. Achieving Emotional Independence from Parents and Other Adults
86. Achieving Assurances of Economic Independence
87. Selecting and Preparing for an Occupation
88. Developing Intellectual Skills and Concepts Necessary for Civic Competence
89. Desiring and Achieving Socially Responsible Behavior
90. Preparing for Marriage and Family Life
91. Acquiring a Set of Values and Ethical System as a Guide to Behavior

6. MAJOR SOCIAL FUNCTION

92. Governing
93. Communicating
94. Transporting
95. Producing
96. Consuming and Conserving
97. Heritage
98. Cooperating
99. Leisure
100. Earning a Living
101. Educating
102. Spiritual/Moral

7. READING LEVEL (RELATIVE TO GRADE LEVEL)

103. Non-Reader
104. Pre-Primer
105. Primer
106. 1
107. 1.5
108. 2
109. 2.5
110. 3
111. 4
112. 5
113. 6
114. 7
115. 8
116. 9
117. 10
118. 11
119. 12
120. Above 12

8. INSTRUCTIONAL ACTIVITY

121. Teacher Activity
122. Dramatization
123. Verbal
124. Non-Verbal
125. Problem Solving
126. Reading
127. Field Trips
128. Writing
129. Listening
130. Speaking
131. Constructing/Creating
132. Laboratory
133. Drill Practice
134. Physical/Tactile
135. Lecture
136. Teacher Led Discussion
137. Student Led Discussion
138. Recitation

9. SUGGESTED APPROACH

139. Introductory Activity
140. Developmental Activity
141. Culminating Activity
142. Extra-Curricular

10. OBJECTIVE TYPES

143. Knowledge
144. Comprehension
145. Application
146. Analysis
147. Synthesis
148. Evaluation
149. Receiving
150. Responding
151. Valuing
152. Organization
153. Characterization by a Value
154. Psychomotor

11. MATERIAL DESCRIPTOR

155. Audio
156. Visual
157. Audio-Visual
158. Verbal
159. Non-Verbal
160. Printed
161. Programmed Instruction
162. 3-D Material/Laboratory
163. Resource/Places/People
173. Bulletin Board Materials

13. INSTRUCTIONAL GROUPING

182. Individual Activity
183. Small Group Activity
184. Large Group Activity

14. EVALUATION DEVICES

185. Standardized Test
186. Paper/Pencil Essay
187. Paper/Pencil Objective
188. Rating Scale
189. Checklist
190. Log/Diary

15. MENTAL AGE

194. .5
195. 1.0
196. 1.5
197. 2.0
198. 2.5
199. 3.0
200. 3.5
201. 4.0
202. 5.0
203. 6.0
204. 7.0
205. 8.0
206. 9.0
207. 10.0
208. 11.0
209. 12.0
210. 13.0
211. 14.0
212. 15.0
213. 16.0
214. 17.0
215. 18.0
216. 19.0
217. 20.0
218. Above 20.0

16. CHRONOLOGICAL AGE

219. 0.5
220. 1.0
221. 1.5
222. 2.0
223. 2.5
224. 3.0
225. 4.0
226. 5.0
227. 6.0
228. 7.0
229. 8.0
230. 9.0
231. 10.0
232. 11.0
233. 12.0
234. 13.0
235. 14.0
236. 15.0
237. 16.0
238. 17.0
239. 18.0
240. 19.0
241. 20.0
242. 21.0

17. PHYSICAL HANDICAPS

243. Blind
244. Partially Sighted
245. Deaf
246. Hard of Hearing
247. Gross Motor Disability
248. Fine Motor Disability

20. LEARNING ENVIRONMENT

258. Classroom
259. Outdoors
260. Gymnasium

APPENDIX 4

Coding Sheet for Variables

UNIT TITLE Communication

UNIT NUMBER 017

CATEGORY Activities	OBJECTIVES — VARIABLES									
124	9	20	23	26	27	29	72	73	78	79
	82	93	99	101	111→	120	123	126	128	139
	140	182	204→	213	229→	237	243	244	245	246
	248	258								
125	9	18	24	27	72	78	93	95	99	115→
	120	123	130	131	134	137	141	182	207→	215
	231→	242	245	246	258					